FOREST RESEARCH REPORT

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS
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A SURVEY OF ONE TO FOUR YEAR OLD BALSAM FIR CHRISTMAS TREE PLANTATIONS ESTABLISHED WITH BAREROOT AND CONTAINER SEEDLINGS

INTRODUCTION

For the past 30 years the Provincial Forest Nursery at Lawrencetown, Annapolis County has been growing balsam fir (*Abies balsamea* (L). Mill.) planting stock for distribution and sale to Christmas tree growers. There has been little information published about the performance of these plantations. This report summarizes the results of a survey to determine the survival and growth of the more recent balsam fir plantings in relation to various cultural measures, stock type and age. It is intended to provide helpful information to Nova Scotia Christmas tree growers.

METHODS

During May and June of 1987, 35 balsam fir Christmas tree plantations were selected for survey in Colchester, Pictou, Antigonish and Hants counties. Each plantation owner was interviewed to determine stock type, stock age, site history and the cultural treatments applied. Subsequent to this interview, 10 sample plots of 2.1 metre radius, were established per 1000 trees, with a maximum of 40 plots per plantation. Plots were located at even intervals along equally spaced parallel cruise lines. For each plot, survival, vigour and height growth were recorded. Since the 1987 height growth was not completed at the time of measurement, the height and leader growth were based on the 1986 values. Survival was calculated according to the following formula:

$$\text{Survival (\%)} = \frac{\text{Living trees}}{\text{Live + dead + missing trees}}$$

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SAMPLE

Although it was planned to sample 6 plantations for each combination of stock type (bareroot 2+2, bareroot 2+1 and multipot) and year established (1983, 1985 and 1986), the objective was not achieved due to insufficient number of plantations in the desired strata (Table 1).

Most of the 35 plantations surveyed were located on old-fields (74%), followed by softwood clearcuts (17%) and mixed-wood clearcuts (9%). Forty percent of these plantations were not treated before or after planting, 20% were only site prepared, 22% underwent only post-planting treatments and 18% received both pre- and post-planting treatments (Figure 1). Site preparation consisted of both chemical (applications of herbicides with a formulation of Simazine) and mechanical (ploughing, disking or raking) treatments. The most common post-planting treatment was the use of herbicides with Roundup®, Vision ® or a formulation of Simazine, followed by fertilization with 10-10-10, 17-17-17 or 25-5-5. In some cases, the herbicide and fertilizer were applied to the same plantation. One plantation received a lime and bark mulch treatment.

Table 1. Number of plantations by stock type and year planted.

Year Planted	Stock Type			Total
	Bareroot 2+2	Bareroot 2+1	Multipot	
1983	1	2	7	10
1985	6	-	6	12
1986	7	6	-	13
Total	14	8	13	35

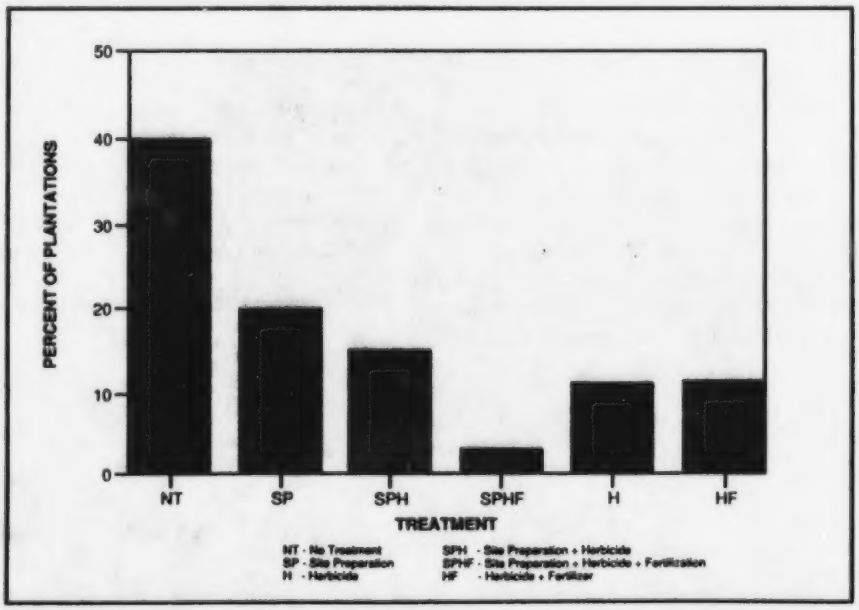

Figure 1. Percent of plantations surveyed by treatment level.

RESULTS AND DISCUSSION

SURVIVAL

The average survival for all plantations was 77% with a range of 0-100%. Fifty-four percent of the plantations had a survival rate greater than 80%, and 9% had a survival rate of less than 40% (Figure 2).

Survival by site history, treatment, stock type and plantation age is shown in Table 2. A treated site is defined here as one which has undergone treatment before or after planting. The highest survival was found on treated sites planted with bareroot stock (93% for old-field sites and 82% for cutovers). In fact, of the 14 sites with greater than 90% survival, 11 had been treated and 13 were planted with bareroot stock. Planting bareroot stock alone cannot guarantee high survival. Two of the untreated bareroot plantations had survival rates of approximately 54%.

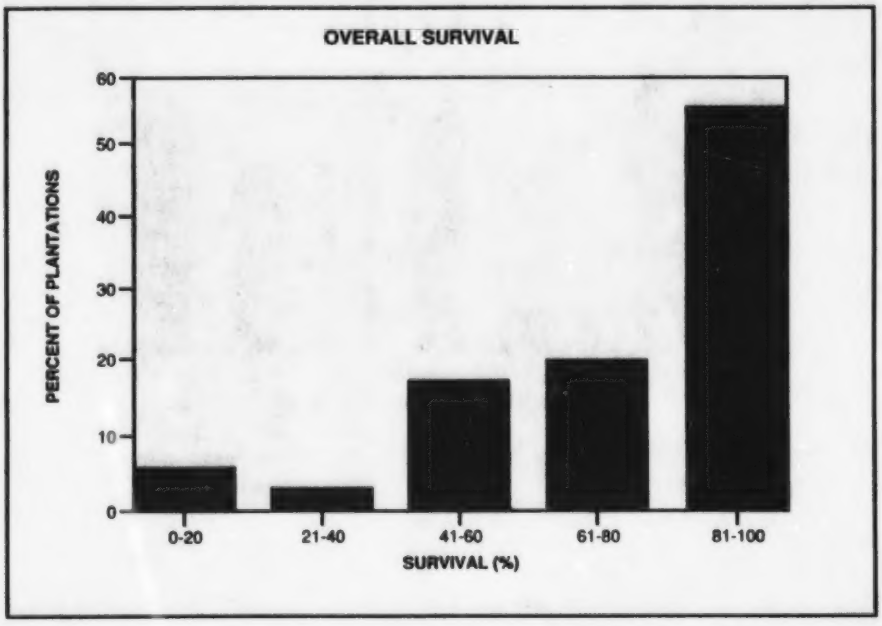

Figure 2. Percentage of plantations surveyed by survival class.

Table 2. Average survival (%) and number of plantations (n) by site history, treatment, stock type and plantation age.

Plantation Age	Old-field				Clearcut			
	Treated		Non-Treated		Treated		Non-Treated	
	BR	MP	BR	MP	BR	MP	BR	MP
4	83(2)	84(3)	-	10(3)	79(1)	-	-	48(1)
2	95(4)	94(1)	-	67(2)	76(1)	88(2)	77(1)	58(1)
1	94(6)	-	81(5)	-	90(1)	-	50(1)	-
Average	93(12)	86(4)	81(5)	33(5)	82(3)	88(2)	63(2)	53(2)

BR - Bareroot
MP - Multipot

Alternately, the poorest survival occurred on multipot planted sites with no treatment (33% on old-field sites and 53% on cutover sites). All 9 plantations with less than or equal to 60% survival had no treatments applied and 7 were planted with multipots. Although multipot plantations showed poor survival when not treated, the 6 multipot plantations that were treated achieved an average survival of 87%.

SEEDLING CONDITION

Thirty-four percent of the plantations had greater than 60% healthy seedlings (Figure 3). The treated plantations, in general, had a higher average percent of healthy seedlings (Table 3). The unhealthy condition in many of the plantations was attributed to a variety of factors among them frost, winterburn, snow breakage,

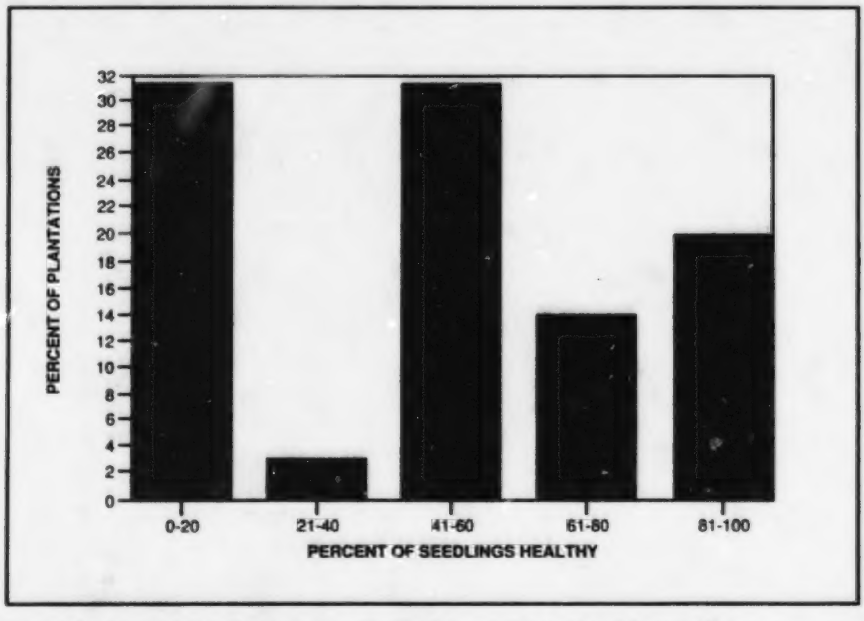

Figure 3. Percent of plantations surveyed by percent of healthy seedlings.

Table 3. Average % healthy and number of plantations (n) by site history, treatment, stock type and plantation age.

Plantation Age	Old-field				Clearcut			
	Treated		Non-Treated		Treated		Non-Treated	
	BR	MP	BR	MP	BR	MP	BR	MP
4	86(2)	51(3)	-	0(3)	66(1)	-	-	16(1)
2	76(4)	53(1)	-	4(2)	53(1)	58(2)	53(1)	14(1)
1	74(6)	-	44(5)	-	11(1)	-	33(1)	-
Average	77(12)	52(4)	44(5)	2(5)	43(3)	58(2)	43(2)	15(2)

BR - Bareroot
MP - Multipot

Table 4. Percentage of plantations and trees damaged by different factors.

Factor	Percentage of Plantations Damaged	Percentage of Trees Damaged per Plantation		Number of Plantations
		Average	(Range)	
Frost	68.6	57.2	(10.9-100.0)	24
Winterburn	48.6	34.5	(1.5-77.3)	17
Snow Breakage	31.4	10.2	(2.0-32.7)	11
Excess herbicide	28.6	36.6	(2.2-94.1)	10
Twig Aphid	5.7	9.4	(1.7-17.1)	2
Other Insects	5.7	2.6	(1.7-3.5)	2

excess herbicide and insect damage. Of these factors, frost was the most common and affected the most seedlings per plantation (Table 4). When selecting sites for Christmas tree production, frost pockets should be avoided so that rotation is not delayed. Frost damage can also be reduced by planting trees grown from seed originating from within the same "seed zone" (Fowler and MacGillivray, 1967).

HEIGHT AND LEADER GROWTH

Average tree heights of 59, 57 and 31 cm and leader growth of 20, 19 and 6 cm were recorded for the 2+2, 2+1 and multipot plantations respectively four years after planting (Figure 4).

If it is assumed that a desired rotation age is 7-10 years, the average height of these plantations is poor. This is attributed to the damaging factors mentioned previously (eg. frost, winterburn, excess herbicide) as well as the failure to appropriately treat the sites (i.e. by site preparation, weeding and/or fertilization).

The average tree height and leader growth by site history, treatment, stock type and plantation age are shown in Appendix I and Appendix II respectively.

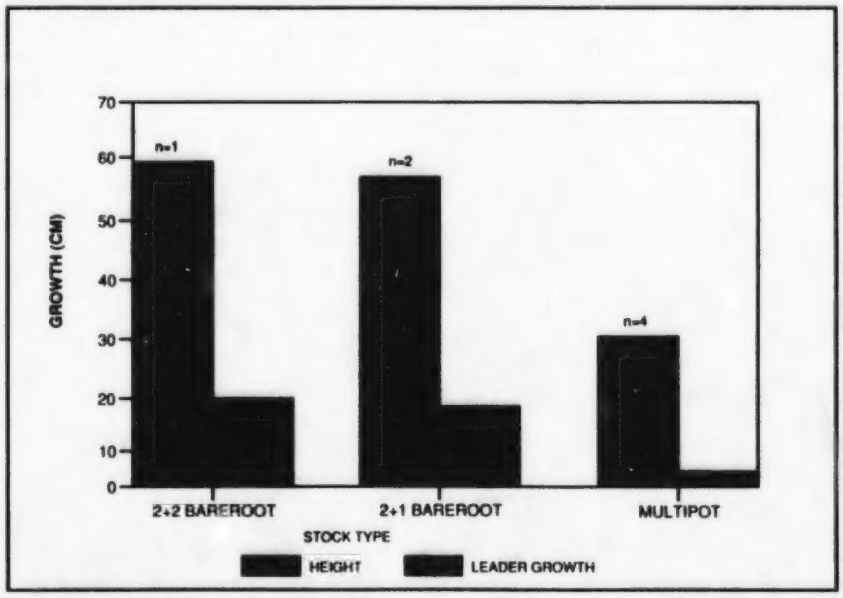

Figure 4. Average height and leader length four years after planting by stock type.

SUMMARY

In this survey 35 balsam fir Christmas tree plantations were assessed to determine the survival and performance of more recent plantings in relation to various cultural measures, stock type and age. A summary of the results follows:

1) Of the 35 plantations surveyed, 74% were located on old-field sites, 17% on softwood clearcuts and 9% on mixed-wood clearcuts.
2) Average survival over all plantations was 77% and ranged from 0-100%.
3) Survival was highest for bareroot stock on treated old-field sites (93%) and lowest for untreated old-field sites planted with multipots (33%).
4) Good survival is possible with both bareroot and multipot stock if proper site preparation and control of competing vegetation are undertaken especially for multipot.
5) Forty percent of the sites surveyed had no site preparation, herbiciding or fertilization treatments.
6) Only 20% of the plantations had 80% or more healthy trees.
7) The percentage of healthy planted trees was considerably higher in the treated plantations, especially for multipot stock.
8) Frost damage was found in almost 70% of the surveyed plantations. The extent of frost damage in these plantations was extensive affecting the growth of over half of the trees.
9) The average tree height for all stock types, was 59, 57 and 31 cm for 4 year old 2+2, 2+1 and multipot plantations respectively.

LITERATURE CITED

Anon., 1987. Christmas tree growers manual Atlantic Canada. Compiled by Nova Scotia Christmas Tree Council, Canadian Forestry Service, and Nova Scotia Department of Lands and Forests. 164 pp.

Fowler, D.P. and H.G. MacGillivray. 1967. Seed zones for the Maritime provinces. Canada Department of Forestry and Rural Development. Forest Research Laboratory, Fredericton, New Brunswick. Information Report M-X 12. 22 pp.

MANAGEMENT RECOMMENDATIONS

Christmas tree growers can improve the survival of their plantations by properly site preparing, weeding and fertilizing especially when multipot stock is planted on old-field sites. To improve growth and health of planted trees: fertilize and avoid planting in areas subject to late frosts. Plant bareroot stock on sites with heavy weed competition. For details see the Christmas Tree Growers Manual (Anon., 1987).

APPENDIX I

Average tree height (cm) and number of plantations (n) by site history, treatment, stock type and plantation age.

Plantation Age	Old-field				Clearcut			
	Treated		Non-Treated		Treated		Non-Treated	
	BR	MP	BR	MP	BR	MP	BR	MP
4	59(2)	31(3)	-		56(1)	-	-	31(1)
2	43(4)	21(1)	-	25(2)	48(1)	27(2)	32(1)	19(1)
1	30(6)	-	28(4)	-	32(1)	-	36(1)	-
Average	39(12)	28(4)	28(4)	25(2)	45(3)	27(2)	34(2)	25(2)

BR - Bareroot
MP - Multipot

APPENDIX II

Average leader growth (cm) and number of plantations (n) by site history, treatment, stock type and plantation age.

Plantation Age	Old-field				Clearcut			
	Treated		Non-Treated		Treated		Non-Treated	
	BR	MP	BR	MP	BR	MP	BR	MP
4	19(2)	5(3)	-	-	20(1)	-	-	10(1)
2	11(4)	2(1)	-	9(2)	12(1)	10(2)	10(1)	7(1)
1	8(6)	-	10(4)	-	12(1)	-	12(1)	-
Average	11(12)	4(4)	10(4)	9(2)	15(3)	10(2)	11(2)	9(2)

BR - Bareroot
MP - Multipot

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